CLAIMS:

1. A process for fabricating a composite material comprising:

a) forming a fibrous structure comprising fibers into a preform;

b) initially predominantly coating the fibers of that fibrous structure preform with elemental carbon to impregnate that preform with elemental carbon;

c) infiltrating the preform with a ceramic slurry to predominantly impregnate the fibers of the preform to form an impregnated green body;

d) infiltrating the impregnated green body with a liquid carbon precursor and pyrolyzing the liquid carbon precursor to form a carbon char;

e) infiltrating the impregnated green body with molten silicon to form a continuous matrix throughout the composite; and

f) reacting silicon in the continuous matrix with the carbon char to form silicon carbide.

2. The process of claim 1, wherein the ceramic slurry contains a boron carbide.

3. The process of claim 1, wherein said fibers are made from polyacrylonitrile.

4. The process of claim 1, wherein said preform is infiltrated by slurry soaking.

5. The process of claim 1, wherein said preform is infiltrated by slurry casting.

6. The process of claim 1, wherein said liquid carbon precursor is liquid naphthalene.

7. The process of claim 1, wherein said molten silicon is a non-alloyed silicon.

8. The process of claim 1, wherein said molten silicon is an alloyed silicon.

9. The process of claim 1, wherein said fibrous structure is initially coated with chemically vapor deposited elemental carbon.

10. The process of claim 1, wherein said elemental carbon is deposited on the fibers using pitch or resin.

11. The process of claim 1, wherein said infiltration with the liquid carbon precursor and pyrolysis is repeated a second time.

12. The process of claim 1, wherein said infiltration with molten silicon occurs in the temperature range of about 1425 to about 1485° C.

13. The process of claim 2, wherein said boron carbide has a particle size of less than about 1 micron.

14. A composite material fabricated by a process comprising:

a) forming a fibrous structure comprising fibers into a preform;

b) initially predominantly coating the fibers of that fibrous structure preform with elemental carbon to impregnate that preform with elemental carbon;

c) infiltrating the preform with a ceramic slurry to predominantly impregnate the fibers of the preform to form an impregnated green body;

d) infiltrating the impregnated green body with a liquid carbon precursor and pyrolyzing the carbon material to form a carbon char;

e) infiltrating the impregnated green body with molten silicon to form a continuous matrix throughout the composite; and

f) reacting silicon in the continuous matrix with the carbon char to form silicon carbide.

15. The composite of claim 14, wherein the ceramic slurry is a boron carbide slurry.

16. The composite of claim 14, wherein said fibers of said preform are made from polyacrylonitrile.

17. The composite of claim 14, wherein said preform is infiltrated by slurry soaking of the liquid carbon precursor.

18. The composite of claim 14, wherein said liquid carbon precursor is liquid naphthalene.

19. The composite of claim 14, wherein said molten silicon is a non-alloyed silicon.

20. The composite of claim 14, wherein said molten silicon is an alloyed silicon.

21. The composite of claim 14, wherein said fibrous structure is initially coated with chemically vapor deposited elemental carbon.

22. The composite of claim 14, wherein said elemental carbon is deposited on the fibers using pitch or resin.

23. The composite of claim 14, wherein said infiltration with molten silicon occurs in the temperature range of about 1425 to about 1485° C.

24. The composite of claim 15, wherein said boron carbide slurry comprises boron carbide having a particle size of less than about 1 micron.

25. A composite ceramic material comprising:

a.) a fibrous structure and a silicon matrix which are initially predominantly impregnated with elemental carbon, and subsequently predominantly impregnated with boron carbide; and

b.) a silicon carbide phase which is continuous and predominantly encompasses said fibrous structure, wherein silicon carbide in said silicon carbide phase has a grain size of less than about 10 microns.

26. A brake disk having an improved wear surface formed from a composite material comprising a silicon carbide matrix, without excess silicon, and having a small grain size.

27. A brake disk according to claim 26 where said silicon carbide matrix composite material exhibits an absence of large SiC grains.

28. A brake disk according to claim 27, where large SiC grains are grains larger than about 20 microns.

29. A brake disk assembly made from the brake disks of claim 26.

30. A process according to claim 1, wherein said boron carbide is a boron carbide slurry.

31. A process according to claim 1, wherein said composite material exhibits an absence of large SiC grains.

32. A process according to claim 31, wherein said large grains are larger than about 20 microns.

33. A composite ceramic material according to claim 25, wherein the amount of unreacted silicon in the matrix is less than that required to form a liquid phase on the wear face of a disk made from the composite material during a severe energy event.

34. A composite ceramic material according to claim 25, wherein said composite material exhibits an absence of large SiC grains.

35. A composite ceramic material according to claim 34, wherein said large grains are larger than about 20 microns.

36. A composite ceramic material according to claim 25, wherein said material is less than 5 volume % residual silicon.

37. A composite ceramic material according to claim 25, wherein said boron carbide comprises about 5 to about 15 volume % of said material.

38. A composite ceramic material according to claim 25, wherein said fibrous structure impregnated with elemental carbon comprises from about 20 to about 45 volume % of said material.

39. A composite ceramic material according to claim 25, wherein said silicon carbide phase comprises from about 20 to about 40 volume % of said material.

40. A composite ceramic material according to claim 25, wherein said boron carbide has an average particle size of less than about 1 micron.

41. A process according to claim 1, wherein said ceramic slurry is chosen from the group of slurries consisting of boron carbide, silicon nitride, boron nitride, aluminum carbide and aluminum oxide slurries.

42. A composite ceramic material according to claim 25, wherein said fibrous structure comprises from about 15 to about 40 volume % of said material.

43. A composite ceramic material comprising:

a.) a fibrous structure and a silicon matrix which are initially predominantly impregnated with elemental carbon, and subsequently predominantly impregnated with boron carbide; and

b.) a silicon carbide phase which is continuous and predominantly encompasses said fibrous structure, wherein silicon carbide in said silicon carbide phase has a grain size of less than about 10 microns.